

WHAT IS CLAIMED IS:

1. An apparatus for the visual inspection of soldered joints between an electric or electronic component disposed on the surface of a printed circuit board and the printed circuit board, the apparatus comprising:

an ocular unit;

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a lens head;

an image transmission unit for transmitting the image received by said lens head to said ocular unit; and

an illuminating device for illuminating the soldered joints to be inspected, said lens head comprising a device for image deviation extending up to an axially outermost end of said lens head, said illuminating device being disposed in said lens head to provide a light exit directed toward the soldered joints to be inspected, said light exit being disposed besides said device for image deviation at the axially outer end of said lens head.

2. The apparatus according to claim 1, wherein said light exit of the light of the illuminating device from the lens head is a bilateral exit next to the device for image deviation.

3. The apparatus according to claim 1, wherein the device for image deviation comprises at least one deviating prism or at least one deviating mirror.

4. The apparatus according to claim 1, wherein the deviation angle of the device for image deviation is between 0 and 180 degrees.

5. The apparatus according to claim 4, wherein the deviation angle of the device for image deviation is substantially 90 degrees.

6. The apparatus according to claim 1, wherein the lens head has a focal length such that the depth of field area of the image corresponds to at least half of a largest component size of the component on the printed circuit board.

7. The apparatus according to claim 1, wherein the lens head comprises a housing with at least one laterally open recess tapering towards the axially outer end of the lens head and bounded on both sides by flange-type webs, wherein a deviating prism or deviating mirror is disposed in the housing to cause a free surface of the deviating prism or the mirror surface in the recess faces outwards and the lower lateral edge of the deviating prism or of the deviating mirror seals the lens head towards the axially outer end, and wherein further the light exits of the illuminating device are arranged in the flange-type webs.

8. The apparatus according to claim 1, wherein the illuminating device comprises at least one glass fiber bundle with first and second ends, said first axial end is connectable to a light source and forms with said second axial end the light exit of the illuminating device on the lens head.

9. The apparatus according to claim 1, wherein the image transmission unit comprises at least one glass fiber bundle which is optically couplable with its first end to the unit for image deviation, and with its second end to the ocular unit.

10. The apparatus according to claim 1, wherein a second illuminating device, positionable substantially in a viewing direction of the apparatus opposite the lens head, illuminates in the direction of the lens head.

11. The apparatus according to claim 10, wherein the second illuminating device comprises a counterlight head with a housing with at least one laterally open recess tapering towards the axially outer end of the counterlight head, wherein in the housing a deviating prism or a deviating mirror, which is optically couplable to a light source via a glass fiber bundle, is disposed with the free surface of the deviating prism or the mirror surface in the recess facing outwards and the lower lateral edge of the deviating prism or of the deviating mirror seals the counterlight head towards the axially outer end.

12. The apparatus according to claim 10, wherein the second illuminating device comprises a counterlight head which is of substantially identical construction to the lens head.

13. The apparatus according to claim 10 wherein the glass fiber bundle at least of the second illuminating device runs in a flexible spiral tube.

14. The apparatus according to claim 11, wherein the glass fiber bundle of the lens head and of the counterlight head are connectable to the same light source.

15. The apparatus according to claim 10, wherein the lens head and the second illuminating

device are couplable via a linkage, rack or similar to provide an exactly defined relative position of lens head and second illuminating device is adjustable.

16. The apparatus according to claim 15, wherein the linkage or rack comprises a freely projecting bracket which is fixable substantially rigidly to a housing section of the apparatus between lens head and ocular unit or is part of the housing section, wherein the bracket comprises, displaceable in longitudinal direction in a guide element, a holding device in which the second illuminating device is fixable, with which the axial distance between lens head and counterlight head  
5 is adjustable.

17. A method for checking the quality of the soldered joint between an electric or electronic component disposed on the surface of a printed circuit board or similar including an SMD, BGA, CSP or FC component, and the printed circuit board, the method comprising the steps of:

using an ocular unit with an apparatus including a lens head, an image transmission unit for transmitting the image received by the lens head to the ocular unit and an illuminating device for illuminating the soldered joints to be tested, in which the lens head comprises a deviating prism for image deviation which extends up to the axially outermost end of the lens head, and in which the illuminating device is disposed in the lens head to cause the exit angle of the light of the illuminating device out of the lens head is substantially equal to the deviation angle of the image deviation and the exit point of the light is disposed next to the deviating prism for image deviation in the area of the axially outer end of the lens head, the component comprising, arranged  
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in rows and gaps after the manner of a matrix, a large number of solder pins, solder balls or solder points which are solderable with a corresponding number of contact points complementary

15 as to shape and function disposed on the printed circuit board;

visually examining the soldered joints of the outermost row of soldered joints of a first side of the component to be tested with the unit, wherein the component is moved step-wise according to the spacing of the solder joint rows or gaps past the lens head of the apparatus or, conversely, the lens head of the apparatus is moved step-wise past the component;

20 rotating of the component or the apparatus through respectively 90 degrees and visually examining the soldered joints of the outermost rows of soldered joints of the further sides of the component with the unit wherein the component is moved step-wise according to the spacing of the solder joints past the lens head of the apparatus or, conversely, the lens head of the apparatus is moved step-wise past the component; and

25 visually examining the channels formed between the respective gaps or rows for optical visibility.

18. The method according to claim 17, wherein said visually examining the channels is performed with a counterlight.

19. The method according to claim 17 wherein in addition to said visually examining the soldered joints and said rotating, at the same time or staggered in time, the soldered joints of the inner rows are examined visually for soldering defects by viewing into the channels formed between the gaps or rows.

20. An apparatus for the visual inspection of soldered joints disposed between an electric or electronic component and a substrate, the apparatus comprising:

an ocular unit;

a lens head;

5 an image transmission unit for transmitting the image received by said lens head to said ocular unit; and

an illuminating device for illuminating the soldered joints disposed between the electric or electronic component and the substrate, said lens head comprising an image deviation device for changing the direction of the image path from an incoming direction from between the electric or electronic component and the substrate to an outgoing direction, said image deviation device extending up to an axially outermost end of said lens head, said illuminating device having a light exit to provide a light exit direction substantially toward said incoming direction, said light exit of said illuminating device being disposed circumferentially besides said device for image deviation.

21. The apparatus according to claim 20, wherein said image deviation device changes the direction of the image path by an image deviation angle, said illuminating device having a light source and a light transmission path changing the direction of light from said light source to said light exit by an angle substantially equal to said image deviation angle.

22. A visual inspection apparatus comprising:

an image transmission unit having a longitudinal axis with first and second ends at opposite longitudinal ends, said image transmission unit transmitting an image from said first end to said second end along said longitudinal axis;

5 a head arranged at said first end of said image transmission unit, said head extending a predetermined distance from said first end of said image transmission unit;

an image deviation device arranged in said head and being receivable of an external image at an image axis angularly spaced from said longitudinal axis of said image transmission unit, said image deviation device being feedable of the external image into said first end of said image transmission unit substantially along said longitudinal axis, said image deviation device being receivable of the external image at substantially a farthest longitudinal distance of said head from said transmission device;

an illuminating device in said head, said illuminating device emitting light substantially parallel to said image axis at a longitudinal position of said image deviation device.

23. An apparatus in accordance with claim 22, wherein:

said image deviation device is receivable of the external image over a longitudinal image distance;

said illuminating device emits the light at a position within said longitudinal image distance.

24. An apparatus in accordance with claim 23, wherein:

said longitudinal image distance has one longitudinal end at said farthest longitudinal

distance of said head;

said illuminating device emits the light at a position adjacent said farthest longitudinal

5 distance.

25. An apparatus in accordance with claim 22, wherein:

said head includes a web longitudinally extending along one side of said image deviation device, said web extending to, or less than, said farthest longitudinal distance.

26. An apparatus in accordance with claim 22, wherein:

said head includes a web longitudinally extending along one side of said image deviation device, said web extending substantially equal to said farthest longitudinal distance.

27. An apparatus in accordance with claim 25, wherein:

said head includes another web longitudinally extending along another side of said image deviation device, said another web extending to, or less than, said farthest longitudinal distance.

28. An apparatus in accordance with claim 27, wherein:

each of said webs define an opening for emitting light from said illuminating device.